

LT Murray Wildlife Area
Fish Passage and Diversion Screening
Prioritization Inventory

Habitat Program
Technical Applications Division
Habitat and Passage Projects Section

Submitted by

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INTRODUCTION

The Washington Department of Fish and Wildlife (WDFW) is committed to providing leadership in restoring salmon and trout (salmonid) populations in Washington State. WDFW conducts Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization projects which address two factors limiting salmonid populations:

- ?? Human-made barriers to fish passage such as culverts and dams
- ?? Salmonid mortality from unscreened or inadequately screened water diversions

When culverts and dams are barriers to fish migration, productive habitat becomes inaccessible. Both adult and juvenile salmonids need to move freely up and downstream to find suitable spawning gravel or disperse from the redd into rearing habitat. Even resident trout need full access to all habitat types to spawn, rear, maximize genetic interchange and survive varying flow conditions.

Juvenile mortality occurs in unscreened or inadequately screened diversions. Water diversion ditches resemble side channels in which juvenile salmonids normally find refuge. But when diversion headgates are shut, access back to the main channel is cut off and the channel goes dry. Mortality can also occur with inadequately screened diversions from impingement on the screen, or mutilation in pumps where gaps or oversized screen openings allow juveniles to get into the system.

Inventories of fish passage barriers and water diversions are being conducted on each of the Wildlife Areas owned or managed by WDFW. The inventories and habitat surveys document and prioritize for correction all human-made fish passage barriers and unscreened or inadequately screened diversions to ensure compliance with Washington State laws (RCW 77.55.060, RCW 77.55.040).

For this report, the location of a fish passage or safety structure is referred to as a site. The structure at that site is referred to as a feature.

Features affecting fish passage include:

- ?? Culverts
- ?? Dams
- ?? Fishways
- ?? Others

Features affecting fish safety include:

- ?? Gravity diversions
- ?? Pump diversions

A site may have one or more features associated with it such as a gravity diversion with a dam to impound water and direct it to the diversion. A dam may be equipped with a fishway to facilitate fish passage around the dam.

This report summarizes the results of the LT Murray WLA inventory with preliminary plans and recommendations to correct the problems identified.

SITE DESCRIPTIONS

LT Murray Wildlife Area

The LT Murray Wildlife Area, comprised of three units totaling 94,352 acres, is located in central Washington near Ellensburg. (See Figure 1) The LT Murray Unit lies west of Ellensburg and the Whiskey Dick and Quilomene units are northeast of Ellensburg adjacent to the Columbia River (WDFW 1997).

LT Murray Unit (54,069 acres)

Largest of the three units, the LT Murray unit provides critical winter range for deer and elk. It is heavily timbered and elevation ranges from 1,200 to 4,700 feet. The Washington Department of Fish and Wildlife, Washington Department of Natural Resources (WDNR), and the United States Forest Service (USFS) all own land within the wildlife area. No logging has occurred on the 39,304 acres of WDFW lands since the timber rights reverted to the department in the fall of 1993. Timber harvest continues on the 14,424 acres of WDNR land. Taneum Campground (341 acres), is USFS land. Intensive livestock grazing ended in 1978 (WDFW, 1997). Several fish bearing streams flow through the unit providing habitat for anadromous and resident salmonids (Photo 1).



Photo 1. Typical stream habitat in the LT Murray unit.



Photo 2. Typical sagebrush habitat of the Quilomene and Whiskey Dick units in the Columbia River Breaks region. Quilomene Creek.

Whiskey Dick Unit (28,549 acres) and Quilomene Unit (17,803 acres)

Located along the Columbia River in the southeastern foothills of the Colockum mountain range, the Whiskey Dick and Quilomene units provide critical winter range for the Colockum deer and elk herds in sagebrush/bitterbrush habitat (WDFW 1997). Whiskey Dick Creek, Quilomene Creek and some of their tributaries provide habitat for resident trout and potentially steelhead. Both the Whiskey Dick and Quilomene units also provide habitat for upland birds. (Photo 2)

Figure 1

METHODS

Inventory/ Feature Evaluation

The inventory encompassed the LT Murray Wildlife Area and additional lands associated with the stream habitat surveys. The Wildlife Area (WLA) manager and regional biologists provided assistance with identifying fish bearing streams and the location of known fish passage and water diversion features, both within and outside the Wildlife Area boundaries.

Using trucks or ATVs, field crews conducted a road inventory by driving or walking all roads along known and possibly fish bearing streams within the WLA. All culverts found in natural drainages were assigned a Site ID number and their geographical locations were recorded using GPS or determined from maps. Data collection and evaluation methodologies for all features are described in the *Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual* (WDFW 2000).

The potential for fish presence was determined based on stream size, gradient, fish observation, flow duration and information provided by WDFW biologists. Each potentially fish bearing stream was walked to measure the habitat, locate additional features not found during the road inventory, and determine the extent of potential fish use. Detailed notes of the habitat, referenced by hip chain distance, were recorded during the habitat survey. All human-made features associated with fish bearing waters were evaluated for fish passage (culvert, dams, fishways) or fish safety (water diversions).

Expected fish species utilization not only includes those species currently inhabiting the stream, but also those which potentially could or have been known to use the stream. Expected fish species utilization was determined by direct observation and by using resources such as the Washington State Salmon and Steelhead Stock Inventory (WDF *et. al.* 1992), Washington State Salmonid Stock Inventory Bull Trout/Dolly Varden Appendix (WDFW 1998), Streamnet, and by personal communication with WDFW regional biologists.

The Washington Department of Natural Resources (WDNR) conducted a fish passage inventory on their lands within the Wildlife Area boundaries (WDNR 2001). Features identified and prioritized by WDNR are included in this report, as well as previously unidentified WDNR owned sites found during the WDFW inventory.

Fish Passage Priority Index

The Fish Passage Priority Index (PI) model consolidates variables which affect a project's feasibility, (species utilization, passage improvement, production potential, habitat gain, project cost, and fish stock mobility and health) resulting in a numeric indicator of relative priority. On streams where fish passage barriers were identified, habitat assessments, data analysis and barrier prioritization were completed per the *Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual* (WDFW 2000).

Screening Priority Index

The Screening Priority Index (SPI) model consolidates the variables relevant to water diversions, (species utilization, volume of flow, production potential, project cost, and fish stock mobility and health) resulting in a numeric indicator of relative priority. PI and SPI are not comparable, because the PI reflects potential production and the SPI reflects potential mortality. In the SPI, the volume of diverted flow is used to estimate of the number of adult equivalent salmonids potentially killed by the unscreened or inadequately screened diversion. The SPI is described in the *Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual* (WDFW 2000).

Prioritization

The PI and SPI values are intended to be used as a guide to prioritizing projects. Other factors need to be considered such as the likelihood of restoring anadromous access. Expected species utilization anticipates correction of all downstream human-made barriers preventing anadromous access, but may be refined to reflect the feasibility of restoring anadromous access, stream size or proximity to known use. Production values predicted for the PI assume all upstream human-made barriers are corrected. The PI and SPI values are dynamic, allowing for modification as new information becomes available.

RESULTS

Inventory

Within the WLA boundaries, 63 features were evaluated on fish bearing streams or streams with unknown fish use including five features evaluated by WDNR (Table 1). Of the 63 features, 36 are partial or total barriers to fish passage. Habitat surveys determined that 34 of the 36 barrier features require repair. Two of the 36 barrier features do not have a minimum threshold gain of at least 200 meters of habitat and are not prioritized for repair at this time.

Of the 34 features requiring repair, 31 are culverts, two are dams and one is an other feature (ford crossing). One of three diversions requires modification making a total of 34 features that require repair or modification.

Outside the WLA, 108 fish bearing features were evaluated during the habitat surveys. These features are listed in Appendix A.

The total potential habitat gain that could be realized from repair of all barriers on the LT Murray Wildlife Area is approximately 52,081 square meters of rearing habitat and 20,503 square meters of spawning habitat, or 53.6 linear kilometers of stream.

The following four tables detail these results. Table 1 summarizes the number of fish passage and diversion features in each unit. Table 2 lists all fish bearing sites within the Wildlife Area with a description of the feature type, repair status and owner type. Table 3 lists all fish passage barriers requiring repair within the LT Murray Wildlife Area with a

Priority Index (PI) value. Table 4 lists the unscreened water diversions requiring repair on the Wildlife Area.

Figures 2 through 7 (pages 15-20) are maps showing the location of all the fish bearing sites inventoried by watershed.

Detailed descriptions of each stream surveyed start on page 21. A complete list of all sites inventoried during the LT Murray WLA inventory is in Appendix A (page 45).

Table 1. Number of fish passage and water diversion features within the WLA listed by unit.

Feature Type	Wildlife Area Units				Total
	Feature Status	LT Murray	Quilomene	Whiskey Dick	
Culvert	Fish Bearing ¹	34	0	0	34
	Fish Barriers ²	32	0	0	32
	Repair Required ³	31	0	0	31
Dam	Fish Bearing ¹	4	2	0	6
	Fish Barriers ²	1	1	0	2
	Repair Required ³	1	1	0	2
Other ⁵	Fish Bearing ¹	6	7	7	20
	Fish Barriers ²	2	0	0	2
	Repair Required ³	1	0	0	1
Water Diversions	Fish Bearing ¹	1	2	0	3
	Unscreened ⁴	0	1	0	1
Total Fish Bearing Features					63
Total Fish Barriers					36
Total Fish Barriers Requiring Repair					34
Total Unscreened Diversions					1
Total Fish Barriers and Diversions Requiring Repair					35

¹ Fish Bearing indicates the number of all barrier and non-barrier features or screened and unscreened diversions on fish bearing streams, or streams with unknown fish use within the WLA.

² Fish Barriers indicates the number of barriers on fish bearing streams and streams with unknown fish use, including No Threshold Gains.

³ Repair Required indicates the number of barriers requiring repair, excluding No Threshold Gains.

⁴ Unscreened indicates the number of water diversions requiring installation or modification of a screen.

⁵ All Other features were ford crossings except for one failing bridge.

Table 2. Features located within the LT Murray WLA on fish bearing streams. The codes in the Repair Status column indicate the feature status where RR = Repair Required, NG = no significant threshold gain, OK = feature is not a barrier or safety issue, no repair required, and UD = habitat gain is undetermined.

Site ID	WRIA	Stream	Tributary to	Feature Type	Repair Status	Owner Type
LT Murray Unit						
NF Manastash Creek						
981552	39.0995	NF Manastash Cr	Manastash Cr	culvert	RR	WDFW
981554	39.0995	NF Manastash Cr	Manastash Cr	other	OK	WDFW
981556	39.1000	Whisky Canyon Cr	NF Manastash Cr	culvert	OK	WDFW
981557	39.1000	Whisky Canyon Cr	NF Manastash Cr	culvert	RR	WDFW
981558	39.1000	Whisky Canyon Cr	NF Manastash Cr	culvert	RR	WDFW
981565	39.1000	Whisky Canyon Cr	NF Manastash Cr	culvert	RR	WDFW
T18R16E-12	39.1001	Unnamed	NF Manastash Cr	culvert	RR	WDNR
T18R16E-6	39.1001	Unnamed	NF Manastash Cr	culvert	RR	WDNR
981524	39.1001	Unnamed	NF Manastash Cr	culvert	RR	WDFW
981525	39.1001	Unnamed	NF Manastash Cr	culvert	RR	WDNR
981526	39.1001	Unnamed	NF Manastash Cr	culvert	RR	WDFW
T18R16E-1	39.1001	Unnamed	NF Manastash Cr	culvert	RR	WDNR
981577	39.0000	Unnamed	NF Manastash Cr	culvert	RR	WDFW
981580	39.0000	Unnamed	NF Manastash Cr	culvert	RR	WDFW
T18R16E-5	39.1002	Unnamed	NF Manastash Cr	culvert	RR	WDNR
981570	39.1002	Unnamed	NF Manastash Cr	culvert	RR	WDFW
981569	39.1002	Unnamed	NF Manastash Cr	dam	OK	WDFW
981571	39.1002	Unnamed	NF Manastash Cr	culvert	RR	WDFW
981575	39.1002	Unnamed	NF Manastash Cr	dam	OK	WDFW
981550	39.1004	Unnamed	NF Manastash Cr	pump	OK	WDFW
Robinson Creek						
981501	39.1064	Robinson Cr	Yakima R	culvert	OK	WDFW
981502	39.1064	Robinson Cr	Yakima R	culvert	RR	WDFW
981505	39.1064	Robinson Cr	Yakima R	culvert	RR	WDFW
981506	39.1064	Robinson Cr	Yakima R	culvert	RR	WDFW
T18R16E-11	39.1064	Robinson Cr	Yakima R	culvert	RR	WDNR
981504	39.1065	Ainsley Cr	Robinson Cr	culvert	RR	WDFW
981521	39.1065	Ainsley Cr	Robinson Cr	culvert	RR	WDFW
981522	39.1065	Ainsley Cr	Robinson Cr	culvert	RR	WDFW
981508	39.1067	Unnamed	Robinson Cr	culvert	RR	WDNR
Joe Watt Creek						
981514	39.1084	Joe Watt Cr	Taneum Ditch	culvert	RR	WDFW
981513	39.1084	Joe Watt Cr	Taneum Ditch	culvert	UD	WDFW
Taneum Creek						
981516	39.1081	Taneum Cr	Yakima R	other	OK	USFS
981592	39.1093	Yahne Cr	Taneum Cr	culvert	RR	WDFW
981515	39.1095	Unnamed	Taneum Cr	culvert	RR	WDFW

Table 2. (Continued)

Site ID	WRIA	Stream	Tributary to	Feature Type	Repair Status	Owner Type
981589	39.1095	Unnamed	Taneum Cr	culvert	NG	WDFW
981583	39.1097	Unnamed	Taneum Cr	culvert	RR	WDFW
981519	39.1098	Shadow Cr	Taneum Cr	culvert	RR	WDFW
981650	39.1098	Shadow Cr	Taneum Cr	dam	OK	WDFW
981517	39.1100	Cedar Cr	Taneum Cr	culvert	RR	WDFW
981523	39.1099	Unnamed	Taneum Cr	other	OK	WDFW
981587	39.1099	Unnamed	Taneum Cr	other	RR	WDFW
981588	39.1099	Unnamed	Taneum Cr	other	NG	WDFW
981725	39.1099	Unnamed	Taneum Cr	other	OK	WDFW
Morrison Canyon Creek						
991464	39.1230	Morrison Canyon Cr	Yakima R	culvert	RR	WDOT
981600	39.1230	Morrison Canyon Cr	Yakima R	dam	RR	WDFW
Quilomene Unit						
Quilomene Creek						
981553	40.0613	Quilomene Cr	Columbia R	other	OK	WDFW
981614	40.0613	Quilomene Cr	Columbia R	dam	OK	WDFW
981614	40.0613	Quilomene Cr	Columbia R	gravity	RR	WDFW
981704	40.0613	Quilomene Cr	Columbia R	other	OK	WDFW
981703	40.0613	Quilomene Cr	Columbia R	other	OK	WDFW
981702	40.0613	Quilomene Cr	Columbia R	other	OK	WDFW
981701	40.0613	Quilomene Cr	Columbia R	other	OK	WDFW
981731	40.0612	Brushy Cr	Quilomene Cr	other	OK	WDFW
981615	40.0000	Unnamed	Quilomene Cr	dam	RR	WDFW
981615	40.0000	Unnamed	Quilomene Cr	gravity	OK	WDFW
981699	40.0642	Hunt Cr	Quilomene Cr	other	OK	WDFW
Whiskey Dick Unit						
Whiskey Dick Creek						
981619	40.0555	Whiskey Dick Cr	Columbia R	other	OK	WDFW
981623	40.0555	Whiskey Dick Cr	Columbia R	other	OK	WDFW
981624	40.0555	Whiskey Dick Cr	Columbia R	other	OK	WDFW
981625	40.0555	Whiskey Dick Cr	Columbia R	other	OK	WDFW
981626	40.0555	Whiskey Dick Cr	Columbia R	other	OK	WDFW
981627	40.0555	Whiskey Dick Cr	Columbia R	other	OK	WDFW
981620	40.0000	Jacknife Cr	Whiskey Dick Cr	other	OK	WDFW

Table 3. Fish passage barriers requiring repair within the LT Murray Wildlife Area with PI (Priority Index) value. Records beginning with “T” indicate features owned and prioritized by Washington Department of Natural Resources (WDNR). Features inventoried by WDNR were not evaluated for percent passability and habitat gain was estimated by WDNR using mapping techniques.

Site ID	Stream	Tributary to	Expected Species Utilization ¹	Feature Type	% Pass-able	Additional Barriers		Habitat Gain			Priority Index (PI)
						Up-stream	Down-stream	Survey Length (m)	Spawning (m ²)	Rearing (m ²)	
LT Murray Unit											
981552	NF Manastash Cr	Manastash Cr	CO/CK/SH/RT/DB	culvert	33	9	7	13,621	5,003	16,006	27.61
981557	Whisky Canyon Cr	NF Manastash Cr	CO/CK/SH/RT/DB	culvert	0	2	7	1,737	488	628	13.79
981565	Whisky Canyon Cr	NF Manastash Cr	CO/CK/SH/RT/DB	culvert	0	0	9	1,165	311	439	12.60
981558	Whisky Canyon Cr	NF Manastash Cr	CO/CK/SH/RT/DB	culvert	33	1	8	1,317	348	494	11.75
T18R16E-12	Unnamed	NF Manastash Cr	CO/SH/RT/DB	culvert						13,497	6.34*
T18R16E-6	Unnamed	NF Manastash Cr	CO/SH/RT/DB	culvert						12,316	6.20*
981524	Unnamed	NF Manastash Cr	RT/DB	culvert	0	3	0	3,417	617	1,537	5.44
981525	Unnamed	NF Manastash Cr	RT/DB	culvert	33	2	1	3,083	740	1,819	5.14
981526	Unnamed	NF Manastash Cr	RT/DB	culvert	33	1	2	3,038	761	1,846	5.16
T18R16E-1	Unnamed	NF Manastash Cr		culvert							
981577	Unnamed	NF Manastash Cr	CO/SH/RT/DB	culvert	33	1	7	804	122	143	6.13
981580	Unnamed	NF Manastash Cr	RT/DB	culvert	33	0	8	453	72	66	2.25
T18R16E-5	Unnamed	NF Manastash Cr	CO/SH/RT/DB	culvert						24,269	6.64*
981570	Unnamed	NF Manastash Cr	CO/SH/RT/DB	culvert	67	1	8	2,023	430	2,035	10.92
981571	Unnamed	NF Manastash Cr	CO/SH/RT/DB	culvert	67	0	9	1,658	380	1,083	9.33
981502	Robinson Cr	Yakima R	CO/CK/SH/RT/DB	culvert	0	6	12	11,804	6,883	11,962	24.20
981505	Robinson Cr	Yakima R	CO/CK/SH/RT/DB	culvert	33	3	13	11,007	5,953	9,789	20.71
981506	Robinson Cr	Yakima R	CO/CK/SH/RT/DB	culvert	67	2	14	10,810	5,762	9,416	17.17
T18R16E-11	Robinson Cr	Yakima R	CO/CK/SH/RT/DB	culvert						5,410	3.57*
981504	Ainsley Cr	Robinson Cr	CO/CK/SH/RT/DB	culvert	0	2	12	3,199	371	1,656	14.04
981521	Ainsley Cr	Robinson Cr	CO/CK/SH/RT/DB	culvert	33	1	13	1,481	0	406	9.59
981522	Ainsley Cr	Robinson Cr	CO/CK/SH/RT/DB	culvert	33	0	14	994	0	290	8.84
981508	Unnamed	Robinson Cr	CO/CK/SH/RT/DB	culvert	0	0	15	3,484	1,277	2,194	16.19
981514	Joe Watt Cr	Taneum Ditch Can.	SH/RT/DB	culvert	67	1	2	1,874	265	918	4.78
981513	Joe Watt Cr	Taneum Ditch Can.	SH/RT/DB	culvert	0	0	3				
981592	Yahne Cr	Taneum Cr	SH/RT/DB	culvert	33	0	1	991	738	875	8.30

Table 3. (Continued)

Site ID	Stream	Tributary to	Expected Species Utilization ¹	Feature Type	% Pass-able	Additional Barriers		Habitat Gain			Priority Index (PI)
						Up-stream	Down-stream	Survey Length (m)	Spawning (m ²)	Rearing (m ²)	
981515	Unnamed	Taneum Cr	RT/DB	culvert	67	0	1	894	270	477	3.08
981583	Unnamed	Taneum Cr	RT/DB	culvert	33	0	1	927	205	510	3.38
981519	Shadow Cr	Taneum Cr	SH/RT/DB	culvert	0	0	1	708	362	641	6.38
981517	Cedar Cr	Taneum Cr	RT/DB	culvert	67	0	1	1,715	282	1,671	4.23
981587	Unnamed	Taneum Cr	RT	other	33	1	1	478	103	100	1.52
981600	Morrison Canyon Cr	Yakima R	RB/EB	dam	33	0	3	60	0	2,160	3.63
991464	Morrison Canyon Cr	Yakima R	RB/EB	culvert	33	1	2	1,082	1,321	2,994	3.95
Quilomene Unit											
981615	Unnamed	Quilomene Cr	CO/SH/RT	dam	0	0	0	120	0	4,608	14.21

¹ Species Codes:

CK – Chinook, CO – Coho, SH – Steelhead, RT – Resident trout, DB – Dolly Varden/Bull trout, RB – Rainbow trout, EB – Eastern Brook trout

* PI values calculated by WDNR used the methods outlined in the April 26, 2001 Washington State Department of Natural Resources *Fish Passage Barrier Inventory and Assessment Project Report (WDNR 2001)*.

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Table 4. Unscreened water diversions within the LT Murray Wildlife Area requiring repair.

Site ID	Stream	Tributary to	Ownership Type	Diversion Type	Associated Dam	Flow (gpm)	Screening Priority Index
Quilomene Unit							
981614	Quilomene Cr	Columbia R	State	Gravity Diversion	Yes	924	5.10

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

DISCUSSION

Culverts constitute nearly all of the fish passage problems within the Wildlife Area. While some culverts need replacement, most only need removal and bank stabilization since many roads are being decommissioned through the Road Management and Abandonment Plan (RMAP).

No natural barriers exist on any of the streams surveyed, downstream of the WLA. All of the fish bearing streams surveyed have potential for anadromous fish use, providing human-made fish passage problems are resolved.

On private agricultural lands downstream, water diversions completely dewater Manastash Creek during summer and fall, and associated dams block fish passage. Efforts are being made to restore flow to Manastash Creek (Montgomery Watson Harza, Inc. 2002). Robinson and Joe Watt creeks flow into screened diversion ditches with no anadromous access to the Yakima River and a high potential for fish mortality from secondary diversions and high water temperature. There are three fishways on Taneum Creek, one of which is a partial barrier to fish passage, downstream of the Wildlife Area eastern boundary.

In the LT Murray unit, sedimentation and streambed instability from road erosion are significant problems, as roads were built adjacent to nearly every stream. In some places all or part of the stream runs down the road. The RMAP will help alleviate these problems as well.

Streams in the Quilomene and Whiskey Dick units flow into the Columbia River. The streams are small, supporting mainly resident trout, but the habitat quality is good.

The following descriptions detail the fish passage barriers, water diversions and physical habitat of each stream surveyed. Refer to tables 2, 3 and 4 for feature, habitat and priority index information and the map figures on pages 15 – 20 for site locations. Bolded site numbers are labeled on the maps.

LT Murray Unit

Manastash Creek Watershed

NF Manastash Creek – WRIA 39.0995 (Map on page 16, Figure 3)

North Fork Manastash Creek was surveyed from the confluence with Manastash Creek to the end of fish use at River Mile (RM) 15.59. Site **981552** (Photo 3), the only barrier on the mainstem within the WLA, is located at RM 10.39. This site consists of two 0.76 meter diameter culverts, evaluated as a partial barrier due to velocity and slope. With a PI of 27.61, this site has the highest PI of any site within the WLA. Potential habitat gain from barrier correction is 16,006 square meters of rearing and 5,003 square meters of spawning (13.62 kilometers of stream including tributaries).

The old bridge, site **981554** (Photo 4), at RM 5.21, is deteriorating but not presently a barrier. Fifteen barriers exist on NF Manastash Creek and tributaries within the WLA. Six more upstream barriers are located west of the WLA on DNR or USFS land.



Photo 3. Site 981552 on NF Manastash Creek. Two 0.76 meter diameter culverts are a partial barrier due to velocity and slope.



Photo 4. Site 981554 on NF Manastash Creek. The old bridge is currently not a barrier but is deteriorating.

Much of North Fork Manastash Creek suffers from sedimentation. There was little evidence of recent beaver activity and the existing beaver ponds are filling in with sediments (Photo 5). Sedimentation may be attributed to degraded sections of the mainstem, the severely degraded tributaries, and silt released from blown-out beaver dams.

Streambed instability, incisement, debris jams, braiding and flow variations are significantly greater on the tributaries than the mainstem (Photo 6). Logging roads were constructed immediately adjacent to and frequently crossing most of the tributaries. In some sections, debris jams divert the tributary flows onto the roads.



Photo 5. A beaver pond on NF Manastash Creek is filling in with silt. Suspended sediments are evident throughout the stream system.



Photo 6. Tributary flow is partially diverted onto an old logging road. Whisky Canyon Creek.

The stream lacks large woody debris, sinuosity and habitat complexity. Canopy cover is very good throughout with occasional openings, usually at beaver ponds and talus slopes. Instream cover varies from low to high. Stream gradient ranges from 1 to 7.5%. Natural fish passage problems occur between river mile (RM) nine and ten. At RM 9.01, there is a 2.1 meter high bedrock cascade. At RM 9.11, two very large boulders, spaced about 0.20 meters apart, constrict the stream and create a hydraulic drop (Photo 7).



Photo 7. At RM 9.11, on NF Manastash Creek, two very large boulders, spaced about 0.20 meters apart, constrict the stream and create a hydraulic drop. At low flows this may be a barrier to fish.



Photo 8. At RM 10.01, on NF Manastash Creek, is a large debris jam that splits the flow into three channels creating hydraulic drops of 1.3 to 2.1 meters. This may be a low flow barrier to fish.

A large boulder and woody debris jam, at RM 9.14, creates a low flow barrier. At RM 10.01 a debris jam splits the stream into three channels with hydraulic drops of 1.3 to 2.1 meters (Photo 8). None of these fish passage problems are total barriers to fish migration, though they may be problems during low flow conditions.

Seven fish bearing tributaries were surveyed including: Whisky Canyon Creek entering the North Fork at river mile 5.12, Bear Canyon Creek entering at 7.69, and five unnamed tributaries entering at RM 10.22, RM 10.75, RM 12.12, RM 12.95 and RM 13.07. The western boundary of the WLA crosses the North Fork at RM 12.30, consequently the last two tributaries surveyed do not flow through the WLA.

Whisky Canyon Creek – WRIA 39.1000 (Map on page 16, Figure 3)

The first culvert encountered at 867 meters upstream of the confluence with NF Manastash Creek, site **981556** (Photo 9), is passable but the culvert is mostly buried and the stream flows around it. Site **981557** (Photo 10), located at 1,098 meters, is a total barrier due to velocity and slope.



Photo 9. Site 981556, located 867 meters upstream on Whisky Canyon Creek, is passable. The red arrow points to the nearly buried culvert along the right bank.



Photo 10. Site 981557, on Whisky Canyon Creek, is a 0.76 meter diameter culvert. This undersized culvert is a total barrier due to velocity and a 6% slope.

Site **981558** (Photo 11) at 1,525 meters, is a partial barrier due to velocity and slope. Site **981565**, (Photo 12), at 1,673 meters is a total barrier due to outfall drop and insufficient water depth in the culvert.



Photo 11. Site 981558, on Whisky Canyon Creek, is a 0.76 meter diameter culvert that is a partial barrier due to velocity and slope.



Photo 12. Site 981565, on Whisky Canyon Creek is a 0.91 meter diameter culvert, is a total barrier due to outfall drop and water depth.

At 2,650 meters upstream, fish use became questionable due to the degraded habitat. The survey continued for another 200 meters to the end of potential fish habitat at 2,850 meters upstream. Fish were observed up to 1,050 meters. Stream gradient ranges from 4 to 7%. Canopy cover is adequate but instream cover is low to moderate. Streambed instability, low summer flow and sedimentation diminish the habitat quality. The road adjacent to the stream likely contributes to the increased flow variations, bedload movement, incisement, sedimentation, channel widening and barrier debris jams common on this stream.

Bear Canyon Creek – WRIA 39.1001 (Map on page 16, Figure 3)

WDNR site **T18R16E-12** (Photo 13), at 51 meters upstream, measures 1.07 meters in diameter. This culvert is a partial barrier due to insufficient water depth. WDNR site **T18R16E-6** (Photo 14), a barrier due to outfall drop and velocity, is located 224 meters upstream. These two barrier culverts are on DNR managed land. A 5.18 meter high falls ends anadromous fish habitat at 1,200 meters upstream.



Photo 13. Site T18R16E-12 on Bear Canyon Creek, is a 1.07 meter diameter culvert just 51 meters upstream of the confluence with NF Manastash Creek. WDNR evaluated this site as a barrier. A barrier falls ends anadromous fish access at 1,200 meters upstream.



Photo 14. Site T18R16E - 6, on Bear Canyon Creek, is a 0.76 meter diameter culvert, 224 meters upstream of the confluence with NF Manastash Creek. WDNR evaluated this site as a barrier.

Upstream of the falls, potential resident trout habitat exists provided the stream flows year round. Site **981524** at 2,195 meters, is a 0.46 meter diameter culvert, which is a total barrier due to velocity, outfall drop and slope. Half of the stream flows through the culvert and half flows in a rough channel alongside the culvert. Site **981525** on WDNR land, is located at 2,529 meters upstream. This 0.46 meter diameter culvert, is a partial barrier because the upstream end of the culvert is buried and most of the flow runs over the ground next to the culvert. Site **981526** at 2,573 meters, is a 0.46 meter diameter culvert which is a partial barrier due to slope. Most of the stream flow overtops the culvert and flows over the road. Upstream of the culvert is a pond. All three culverts are undersized. WDNR site **T18R16E-1** at 4,323 meters, is a 0.91 meter diameter culvert that is a partial barrier.

Trout were observed below the falls but not above. The survey ended at 4,966 meters due to obliteration of the stream by timber harvest machinery repeatedly driven over the channel. Limiting factors for Bear Canyon Creek include sedimentation, bedload movement and lack

of sinuosity due to the adjacent logging road. Stream habitat quality is poor upstream of the falls.

Right Bank Tributary – WRIA 39 (Map on page 16, Figure 3)

This tributary enters the North Fork at RM 10.22. Site **981577**, at 351 meters, is a 0.46 meter diameter culvert which is a partial barrier due to velocity and slope. Site **981580** (Photo 15), at 701 meters, is also a 0.46 meter diameter culvert which is a partial barrier due to velocity and slope.



Photo 15. Site 981580 features a 0.46 m diameter culvert which is a partial barrier due to velocity and slope. This culvert is 701 m up a right bank tributary to NF Manastash Creek.

Fish were observed in the first 70 meters. Potential fish habitat becomes questionable at 300 meters upstream where the incised channel is about 0.91 meters wide. The stream channel conditions alternate between incisement and aggradation. Frequent 1 to 2 meter hydraulic drops are low flow barriers. Assuming the habitat could be restored, the survey continued to the end of fish habitat at 1,155 meters upstream. Gradient ranges from 5.5 to 13.5%. Canopy cover is good but instream cover is low to moderate. Limiting factors include streambed instability, extreme flow variations, sedimentation, channel widening and barrier debris jams. A road runs adjacent to the stream.

Left Bank Tributary – WRIA 39.1002 (Map on page 16, Figure 3)

Entering the North Fork at RM 10.75, this tributary parallels Murray Road. Features encountered include three barrier culverts and two passable dams. At 63 meters, WDNR site **T18R16E-5**, consists of two 0.91 meter diameter culverts, plus an overflow culvert outside the active channel. These culverts, under NF Manastash Road, are a partial barrier due to slope. Site **981570** (Photo 16), at 586 meters, is a 0.46 meter diameter, partial barrier culvert due to velocity and slope. At 735 meters is a dam, site **981569**, with a passable cascade overflow. At 944 meters, a pair of 0.61 meter diameter culverts create a partial barrier to fish

passage, site **981571** (Photo 17). Site **981575** at 2,588 meters features a dam with a passable cascade overflow .



Photo 16. Site 981570 is located 586 meters up an unnamed tributary to NF Manastash Creek. The 0.46 m diameter culvert is a partial barrier due to slope and velocity.



Photo 17. Site 981571, is 944 meters upstream on an unnamed tributary to NF Manastash Creek. A pair of 0.61 m diameter culverts create a partial barrier due to a 4.6% slope. This site is on Murray Road.

Fish were observed up to 1,131 meters and at 1,526 meters fish presence becomes questionable due to intermittent flow. The survey crew noted the end of fish habitat at 2,723 meters upstream. Gradient ranges from 3 to 5%. The stream flows through meadow habitat with willow, alder and shrub canopy cover along both banks. At 1,038 meters upstream, canopy cover decreases and the entire area is clear-cut. Instream cover is low to moderate. Limiting factors include lack of cover, streambed instability, sedimentation, low summer flow, and numerous debris jams.

Right Bank Tributary – WRIA 39.1004 (Map on page 16, Figure 3)

No human-made fish barriers were found on this tributary entering the North Fork at RM 12.12. There is a diversion, site **981550**, behind the WDFW log cabin on the right bank. The diversion consists of a concrete culvert placed vertically in the streambed with a small pipe protruding from the gravel inside the culvert. The top of the culvert is high enough to prevent the stream from flowing in, so it cannot trap fish.

Gradient ranges from 5 to 8.75%. Canopy and instream cover are good. Limiting factors are channel widening and braiding, low summer flow and sedimentation. Due to incisement on the mainstem, this tributary drops approximately 2.5 meters into North Fork Manastash Creek, which may explain why no fish were observed in this stream. The survey continued to the end of fish habitat at 966 meters upstream.



Photo 18. Site 981567, a 0.46 meter diameter culvert. Partial barrier due to slope. Unnamed tributary to NF Manastash Creek.



Photo 19. Site 981568, a ford crossing eroding the road. Unnamed tributary to NF Manastash Creek.

Right Bank Tributary(not on WLA) – WRIA 39 (Map on page 16, Figure 3)

Entering the North Fork at RM 12.95, this tributary is outside of the WLA. At 64 meters, the feature at site **981567** (Photo 18), is a 0.46 meter diameter culvert buried under large woody debris. It is a partial barrier due to slope. At 655 meters, a ford crossing, site **981568** (Photo 19), is a partial barrier due to outfall drop off the eroded road bed.

The survey continued to the end of potential fish habitat at 672 meters upstream. No fish were observed but, visibility was poor because of abundant cover and subsurface flow. Stream gradient ranges from 8 to 10%. Canopy and instream cover are excellent. Limiting factors include subsurface flow, low summer flow, degradation, aggradation and sedimentation.

Right Bank Tributary (not on WLA) – WRIA 39.1005 (Map on page 16, Figure 3)

No features were encountered on this tributary, entering the North Fork at RM 13.07. It is also outside the WLA. Stream gradient ranges from 4.5 to 17.5%. Canopy and instream cover are good. Limiting factors are low summer flow and sedimentation. Fish were observed up to 705 meters. The survey continued to the end of potential fish habitat at a barrier cascade located 1,000 meters upstream.

NF Manastash Creek Downstream Verification (Map on page 15, Figure 2)

Salmonid access was verified and additional features were located and evaluated by walking Manastash Creek from the confluence with the Yakima River upstream to the confluence with North Fork Manastash Creek. No natural barriers exist. From the WLA boundary downstream to the Yakima River there are nine passable dams, seven barrier dams, one

barrier culvert, thirteen adequately screened pump diversions, seven inadequately screened pump diversions and nine unscreened gravity diversions.

Stream flow was intermittent at the time of the survey (September 24, 2002), due to the active diversions and streambed instability. The stream is moderately to well shaded by a tree buffer along both banks. Instream cover is low to moderate due to scour and incisement. Adjudicated water right allotments typically exceed stream flow from July through October. The Washington Environmental Council, the Kittitas Conservation District and Yakama Indian Nation are working to restore stream flow to Yakima River tributaries including Manastash Creek (Montgomery Watson Harza, Inc. 2002).

Robinson Creek Watershed

Robinson Creek – WRIA 39.1064 (Map on page 17, Figure 4)

Severe channel scour has resulted in incisement in some sections of Robinson Creek and channel aggradation has caused streambed widening in others. Abandoned logging roads run adjacent to and frequently cross the mainstem and tributaries. High peak flows, as evidenced by incisement, aggradation and sub-surface flow, are intense but short lived, in the upper and lower portions of the mainstem and the intermittent tributaries. The decommissioning of roads along the creek has decreased the potential for erosion.

Spawning is impacted by embedded substrates. The stream lacks large woody debris, resulting in long riffles and few pools. Small woody debris jams create large drops, channel widening, braiding and incisement. A few small fish were observed in the mainstem but suspended sediments made observing fish difficult. Gradient ranges from 2 to 7.5%. Canopy and instream cover are moderate in the lower section but lacking in the upper section.

The survey began at the first culvert within the WLA, site **981501**, at RM 6.97. This culvert is passable. All mainstem distances were measured from this culvert. Site **981502** (Photo 20), at 2,365 meters is the first barrier encountered. This 1.07 meter diameter culvert is a total barrier due to outfall drop and velocity. Within the WLA, this feature has the second highest PI value, 24.2. Potential habitat gain estimated from correction of this barrier is 11,962 square meters of rearing habitat and 6,883 square meters of spawning habitat (11.80 kilometers of stream, including tributaries).

At 3,158 meters, site **981505** (Photo 21), is a squash culvert which is a partial barrier due to outfall drop. The PI value is 20.71 and the potential habitat gain is 11.0 kilometers of stream with 5,953 square meters of spawning and 9,789 square meters of rearing habitat.



Photo 20. Site 981502 is the first barrier encountered on Robinson Creek in the WLA. This 1.07 m diameter culvert is a total barrier due to a 0.58 m outfall drop, and a 3% slope. This feature has the second highest PI value, 24.20.



Photo 21. Site 981505, on Robinson Creek, is a 1.75m squash culvert. It is a partial barrier due to a 0.36 m outfall drop and a 4.8% slope. The PI value for this site is 20.71.

Site **981506** (Photo 22), is a 0.91 meter diameter culvert. This culvert is a partial barrier due to slope and velocity. At 6,288 meters the stream forks. The right fork contributes 95% of the flow and the left fork, considered the mainstem, is nearly dry. Fish were observed up to this point. WDNR site **T18R16E-11**, at 6,354 meters is a 0.91 meter diameter culvert that is a total barrier due to outfall drop and slope. Flow is now intermittent and fish use is unknown. The mainstem survey continued to the end of potential fish use, 7,900 meters upstream of site 981501.



Photo 22. Site 981506, on Robinson Creek, is a 0.91 m diameter culvert that is a partial barrier due velocity and a 2.6% slope. The PI value for this site is 17.17.



Photo 23. Site 981504, at the mouth of Ainsley Creek, has a pair of perched culverts that are a total barrier to fish passage. This site blocks fish access to 3.2 km of stream.

Ainsley Creek – WRIA 39.1065 (Map on page 17, Figure 4)

Site **981504** (Photo 23), at the mouth of Ainsley Creek is a total barrier to fish passage due to outfall drop and velocity. This site blocks fish access to 3.2 kilometers of stream.

Potential habitat gain is 1,656 square meters of rearing and 371 square meters of spawning. At 1,710 meters, site **981521** (Photo 24), a 1.62 meter squash culvert is a partial barrier due to slope. Site **981522** (Photo 25), at 2,203 meters, consists of a 0.61 meter diameter culvert and a 0.91 meter diameter overflow culvert. This feature is a barrier due to slope and velocity.



Photo 24. Site 981521, on Ainsley Creek. This 1.62 m squash culvert is a partial barrier due to a 5.7% slope.



Photo 25. Site 981522 on Ainsley Creek. The red arrow points to a 0.61m diameter culvert. The culvert on the left is a 0.91m diameter overflow culvert.

No fish were observed in this tributary. The survey continued to the end of potential fish habitat at 3,209 meters upstream. Stream gradient ranges from 4 to 12%. Canopy and instream cover are good. The habitat is severely degraded by embedded gravels, incisement, sub-surface flows, barrier debris jams, extreme scour and bed load movement.

Right Bank Tributary – WRIA 39.1066 (Map on page 17, Figure 4)

No fish passage barriers were encountered on this tributary entering Robinson Creek at 5,204 meters upstream of site 981501. Fish were observed in the first 60 meters of the stream. At this point incisement creates an approximately 0.61 meter drop. A short distance upstream, a series of beaver dams block fish passage. There was some recent beaver activity, but all the ponds are filling in with silt and algae.

At 894 meters upstream, fish use becomes questionable where the bankfull width decreases to about 1.0 meter. The survey continued to the end of potential fish use at 2,591 meters upstream. Stream gradient ranges from 7 to 12%. Canopy and instream cover are low initially, but improve 870 meters upstream at the end of the series of beaver ponds. Limiting factors include lack of cover, low summer flow and sedimentation. An adjacent, decommissioned road frequently crosses the creek.

Right Bank Tributary – WRIA 39.1067 (Map on page 17, Figure 4)

This tributary, entering Robinson Creek at 6,288 meters, provides about 95% of the flow to the mainstem. Site **981508** (Photo 26), located 202 meters upstream, is on WDNR managed land. This pair of 0.46 meter diameter culverts are buried at the upstream end, but a small amount of flow seeps through. Most of the stream flows over the road and rejoins the stream

channel a short distance downstream. This site looks like a ford crossing and the culverts are difficult to find. Stream gradient ranges from 3.5 to 7%. Canopy and instream cover are good. Limiting factors are lack of habitat complexity, low summer flow, severe scour and sedimentation.



Photo 26. Site 981508 is located on a right bank tributary to Robinson Creek. This pair of 0.46 m diameter culverts are buried at the upstream end, but a small amount of flow seeps through. Most of the stream flows over the road and rejoins the stream channel a short distance downstream.

A decommissioned logging road runs adjacent to the stream, crossing it many times. The road is becoming overgrown. No fish were observed during the survey. At 3,207 meters upstream fish use becomes questionable due to channel braiding and insufficient water depth. The survey continued to the end of potential fish habitat at 3,686 meters upstream.

Robinson Creek Downstream Verification (Map on page 17, Figure 4)

Robinson Creek flows into the Packwood Canal, which is a diversion off of the Yakima River. The diversion is screened at the west end where it is diverted from the Yakima River. The east end of the canal ends at a barrier dam and an old, abandoned power plant. The fish screen and the dam prevent anadromous access from the Yakima River.

Ideally, Robinson Creek should flow into the Yakima River and not enter Packwood Canal. The canal is poor fish habitat due to high temperatures, lack of cover and questionable water quality from irrigation return water. The canal has four barrier dams, eleven gravity diversions, four pump diversions and one passable culvert between the power plant and the point where Robinson Creek enters the canal.

Dewatering of Robinson Creek reduces salmonid habitat and restricts migration. During summer the stream goes dry from the WLA downstream to where Taneum Ditch spills overflow water into the stream. Between the WLA boundary and its confluence with the Packwood Canal, Robinson Creek has three barrier dams, one passable dam, five barrier culverts, six passable culverts, seven gravity diversions, two pump diversions and one passable ford crossing.

Joe Watt Creek Watershed

Joe Watt Creek – WRIA 39.1084 (Map on page 18, Figure 5)

Within the Wildlife Area, Joe Watt Creek has potential habitat for fish, but no fish were observed. The stream is small but has year round flow in the lower portion of the WLA. The upstream survey began at the first culvert within the WLA, site **981514** (Photo 27) located on Hutchins Road. This 0.76 meter diameter culvert is a barrier due to slope.



Photo 27. Site 981514 is located on Joe Watt Creek where it crosses Hutchins Road. This 0.76 m diameter culvert is a partial barrier due to slope.



Photo 28. Site 981513 is 2,014 m upstream of the Hutchins Road crossing. This 0.76 m diameter culvert is a total barrier due to slope and outfall drop.

Flow went subsurface due to streambed scour, incisement and braiding at 1,874 meters upstream of the Hutchins Road crossing. This intermittent section of stream may support fish when there is flow. Surface flow returns approximately 1000 meters upstream. Located 2,014 meters upstream of the Hutchins road crossing, site **981513** (Photo 28) is a culvert on an abandoned spur road off of Joe Watt Canyon Road. At this site, the stream is considered to have unknown fish use and habitat gain could not be determined since the stream was dry when surveyed on May 2, 2002. This 0.76 meter diameter culvert is a total barrier due to a 5% slope and a 0.21 meter outfall drop.

Canopy and instream cover are good. Stream gradient ranges from 3.5 to 9.5%. Limiting factors include streambed instability and intermittent flow.

Joe Watt Creek Downstream Verification (Map on page 18, Figure 5)

Downstream of the Wildlife Area boundary there are two more fish passage barriers. At site **981547**, Joe Watt Creek flows through a culvert under the South Branch Canal and access road. This culvert is a total barrier due to a 7.7% slope and insufficient water depth. Site **981706** is a private road culvert that is a partial barrier due to slope. Immediately

downstream of site 981706 is site **981719**, an unscreened diversion and a passable dam which directs flow into a field. Further downstream is a pond with a dam and standpipe which appears to be a barrier. Permission to walk the stream and evaluate the dam was denied, but the pond is visible from the South Branch Canal access road. The pond is stocked with fish.

Joe Watt Creek flows into Taneum Ditch, a screened diversion off of Taneum Creek. This screened structure prevents anadromous access although it is unlikely the stream would get much anadromous use due to the stream size and 12% gradient.

Taneum Creek Watershed

Taneum Creek – WRIA 39.1081 (Map on page 18, Figure 5)

Thirty sites were evaluated in the Taneum Creek watershed within the wildlife area. Twelve of these sites are on potentially fish bearing streams. Only one site exists on the mainstem, a passable ford crossing, site **981516** at RM 8.76. This ford crossing is located on USFS land in Taneum Campground. Six barrier culverts, one passable dam and four 'other' sites are located on tributaries. See Table 2.

Outside and downstream of the Wildlife Area, Taneum Creek has three water diversions, sites **981696**, **981697**, **981698**, and one passable ford crossing, site 981720. Each diversion site has a gravity diversion, dam and fishway. All three diversions are properly screened. The fishway at site 981697 is a partial barrier due to outfall drop and the other two fishways, (sites 981696, 981698) need further evaluation.

Just below the dam, at site 981696 (Bruton diversion) is a left bank, wastewater return ditch. This diversion channel is screened at the upstream end but not at the downstream end where it re-enters Taneum Creek. It may provide an attraction flow to salmonids that could result in mortality so this site, 981730, requires a screen or fish barrier to prevent fish access into the diversion.

During the downstream survey, the inventory crew was denied access to a short section of stream below site 981698, (Knudson Diversion). Previous reports indicate a fourth irrigation diversion with a large gravel berm is located in this section. This structure washes out during high flows and it is possible that the diversion was not constructed for the 2002 irrigation season (Washington State Conservation Commission 2001). Although this stream reach was not walked, the inventory crew was able to visually observe the majority of this section and no diversion was seen.

Taneum Creek has generally stable habitat within the Wildlife Area. Observations include: many riffles with substrates suitable for spawning, 2-4 % stream gradient throughout, favorable summer and fall water flow and temperatures, an average of 60% canopy cover and low to moderate amounts of instream cover. Habitat quality is slightly impacted by aggraded bedload deposition, incised banks, sedimentation and limited channel complexity

due to a lack of large woody debris. Some fish were observed. Taneum Creek has the potential of producing substantial numbers of salmon and trout.

The seven potentially fish bearing tributaries surveyed enter Taneum Creek at RM 5.35 (Yahne Cr.), 5.85, 8.15, 8.60 (Shadow Cr.), 10.20 (Cedar Cr.) 10.43 and 10.51. The only tributary surveyed without anadromous access to Taneum Creek, is at RM 10.43 which has a natural barrier falls near the confluence. All of these tributaries have, to some degree, been impacted by past timber harvest activities and are in a state of recovery. Physical surveys were conducted to calculate the potential habitat gain associated with barrier removal or repair. Restoration efforts should focus on removal of culverts and bank stabilization.

Yahne Creek – WRIA 39.1093 (Map on page 18, Figure 5)

Yahne Creek has the physical potential to be fish bearing but no fish were observed. A pair of culverts, site **981592** (Photo 29) located 118 meters upstream, partially block fish passage. Correction of this barrier will open 991 linear meters of stream with an estimated gain of 738 square meters of spawning and 875 square meters of rearing habitat. A natural barrier falls ends anadromous access and potential fish use at 1,085 meters upstream. Due to summer drying, sections of high gradient and degraded habitat, the stream above the falls is considered not fish bearing.

The available habitat has 100% canopy cover, moderate instream cover, and 8 to 13% stream gradient with a high riffle to pool ratio. Factors limiting fish production are streambed scour and low summer flow.

Right Bank Tributary – WRIA 39.1095 (Map on page 18, Figure 5)

Entering Taneum Creek at RM 5.85, this tributary also has the physical potential to support fish, but no fish were observed. An initially steep gradient (17%) and a small volume of flow limit fish access into this tributary.

A barrier culvert, site **981515** located at 79 meters upstream, partially blocks fish passage. Correction of this barrier will open 894 linear meters of stream with an estimated gain of 270 square meters of spawning and 477 square meters of rearing habitat. A natural barrier falls ends anadromous access at 945 meters. Potential resident fish habitat exists above the falls. Barrier culvert **981589**, located above the falls, is considered a No Threshold Gain site due to a lack of usable habitat immediately upstream, (gradient exceeds 20% for 160 m).

The habitat quality of this small, steep stream is moderately degraded by sections of unstable channel (scoured and incised or braided and wide). The available habitat has 95% canopy cover, sufficient instream cover, and 16% average stream gradient. Limiting factors include lack of spawning habitat, high riffle to pool ratio and numerous hydraulic drops created by small woody debris jams and channel incisement.

Right Bank Tributary – WRIA 39.1097 (Map on page 18, Figure 5)

Entering Taneum Creek at RM 8.15, this tributary has one barrier culvert, site **981583**, at 704 meters, partially blocking upstream access. Barrier correction will result in a potential

habitat gain of 927 lineal meters of stream with an estimated 205 square meters of spawning and 510 square meters of rearing habitat.

Although this stream meets the physical criteria necessary to be considered fish bearing, the severely degraded habitat limits potential fish production. Stream gradient ranges from 9 to 16% with a high percentage of rapids and very few pools. Canopy cover averages 95% and instream cover is moderate. Fish production is limited by excessive fine sediments in the substrate, intermittent flow, channel incisement and braiding.

Shadow Creek – WRIA 39.1098 (Map on page 18, Figure 5)

Shadow Creek enters Taneum Creek at RM 8.60. Site **981650**, at 258 meters upstream, is a dam once used to divert water to a Forest Service campground. Currently passable and in fair condition, this structure could potentially be used again by inserting stop boards. At 1,881 meters, the culvert at site **981519** (Photo 30), is a total barrier due to slope and velocity. The potential habitat gain from barrier correction is 708 linear meters of stream with an estimated 362 square meters of spawning and 641 square meters of rearing habitat.



Photo 29. Site 981592, on Yahne Creek, is a pair of 0.31m diameter culverts. This is a partial barrier due to slope and velocity.



Photo 30. Site 981519, on Shadow Creek, is a 0.91m diameter culvert that is a total barrier due to a 5.5% slope and velocity.

Fish were observed up to 2,452 meters. A 7.32 meter high barrier falls ends access for anadromous fish at 2,598 meters. Upstream of the falls is considered non-fish bearing due to intermittent flow and lack of refuge habitat. The stream gradient ranges from 9 to 16% and a narrow riparian corridor of thick shrubs provides excellent canopy cover. Limiting factors include little spawning habitat and unstable channel characterized by deposition, braiding, streambed scour and deep incisement.

Cedar Creek – WRIA 39.1100 (Map on page 18, Figure 5)

Cedar Creek enters Taneum Creek at RM 10.20. At 350 meters, the culvert at site **981517**, under Taneum Creek Road, is a partial barrier because of slope. The potential habitat gain from barrier correction is 1,715 linear meters of stream with an estimated 282 square meters of spawning and 1,671 square meters of rearing habitat. At 1,502 meters a decommissioned road crosses the stream. The road material has been removed and the channel returned to a natural condition. A barrier falls ends anadromous fish habitat at 2,065 meters upstream. Upstream of the falls, the fish bearing status is unknown and no additional human-made features were identified on the Wildlife Area. Downstream of site 981517 the stream flows parallel to Taneum Creek and the confluence is a considerable distance downstream of the mapped location. No fish were observed during the survey.

The stream gradient averages 12%, with several short sections of 16-18% gradient. The riparian zone is relatively intact and canopy cover averages 90% with thick understory in areas of talus slopes. Springs maintain consistent flow and temperature conditions to 1,292 meters upstream. Minor sections of subsurface flow occur to approximately 1,650 meters upstream during the summer. Further upstream, flow is more intermittent with segmented habitat due to subsurface flow. Near the falls several boulder-formed pools provide salmonid refuge habitat during low flows.

Logging has significantly impacted this stream. Woody debris jams accumulating depositional sediments create hydraulic drops. A lack of channel complexity, excessive channel instability and sedimentation throughout the majority of the stream diminishes the habitat quality.

Right Bank Tributary – WRIA 39.1099 (Map on page 18, Figure 5)

Based on mapped WRIA numbers (WDNR hydrology mapping), a U.S.G.S. quadrangle map, and field observations, it is apparent that the stream course of this tributary was altered during road construction. The *Columbia River Basin River Mile Index* indicates the Taneum Creek confluence is at RM 10.23, but the main flow of this stream has been diverted and now enters Taneum Creek approximately 445 meters upstream, at RM 10.51. Currently, the perennial source contributing flow to stream number 39.1099 (RM 10.23) barely meets fish bearing criteria. Fish bearing status is unknown. Two non-barrier crossings, sites **981523** and **981725**, were identified during the survey. At each site the stream has cut a channel through the abandoned road bed.

Immediately downstream of site 981523 the stream gradient is 60 to 70% and drops approximately three meters down to the valley floor and an emergent wetland habitat. No maintained channel or confluence to Taneum Creek was found at the time of the survey.

The limiting factors on this low energy stream include shallow water depth, and a lack of pool and spawning habitat. Potential fish habitat ended approximately 300 meters upstream of site 981725.

Right Bank Tributary – WRIA 39 (Map on page 18, Figure 5)

Three sites were identified on this unnamed tributary, which enters Taneum Creek at RM 10.51. A natural barrier falls, located 180 meters upstream, precludes anadromous access. At the top of the falls is site **981588**, where a decommissioned road crosses the stream. Continuous stream incisement transports unstable road fill downstream. Although this site has no habitat gain, the possibility of hillslope failure should be addressed.

Potential fish habitat continued upstream of site **981587** at 488 meters and ended shortly below site **981585** at 966 meters where the stream gradient exceeds 20%. Road construction likely initiated the altered stream course at this location. Flow from the tributary above, WRIA 39.1099, is diverted into this drainage. Much of the stream below 981587 lacks a defined channel and fish habitat has not yet developed.

Morrison Canyon Creek Watershed

Morrison Canyon Creek – WRIA 39.1230 (Map on page 18, Figure 5)

The stream was dry at the time of the survey (June 13, 2002) except for a pond created by the dam at site **981600**. Flow coming from the pond outlet went subsurface at the confluence with the natural stream channel. The natural channel is severely aggraded with multiple braided channels weaving through trees and shrubs. Accumulated leaf material and vegetation in the channel indicates a short, seasonal flow duration.

The pond outlet channel is 110 meters long and gradient ranges from 1 to 7% with a natural bedrock cascade (Photo 31), 1.5 meters high, near the end. This cascade is the reason site 981600 is a barrier.



Photo 31. Site 981600 on Morrison Canyon Creek features a dam with an overflow channel 110 m long. This 1.5 m high cascade on the overflow channel is a low flow barrier.

Fish access could be improved but that raises the question of salmonid use of the pond. On June 13, 2002, the pond water temperature was 19 degrees centigrade with very little shade provided by trees or shrubs.

Immediately upstream of the pond, the stream channel is 1.0 meter wide and intermittent. It is unlikely to sustain three months of flow, and the potential for fish habitat ends. Further study would be needed to verify fish use in the creek and the pond to determine the value of improving fish passage at dam site 981600. Currently the repair status of the dam is designated as repair required and potential salmonid use of the stream is unknown.

Verification of the WLA boundary revealed that site 991464, a barrier culvert under I-90, is within the WLA. One more culvert exists under Elk Heights road that will be inventoried when weather permits.

Quilomene Unit

Quilomene Creek Watershed

The Quilomene Creek basin lies in the dry, shrub-steppe habitat along the Columbia River northeast of Ellensburg. Little snow pack accumulates, so flows are not greatly influenced by spring snowmelt. Flows remain fairly constant due to the springs scattered throughout the drainage. The survey was conducted during July and August 2002.

Although all the ford crossings are passable, they do impact fish. For instance, site **981704** (Photo 32) contributes fine sediments from bank erosion. This picture was taken after a hunter's truck recently negotiated the crossing. Many fords are steep and soils are loosened as vehicles' spinning tires churn up the banks.



Photo 32. Site 981704 on Quilomene Creek, is a passable ford crossing but unstable banks contribute fine sediments to the stream. This picture was taken after a hunter's truck recently negotiated the crossing.



Photo 33. Site 981699, on Hunt Creek, also a passable ford crossing. Fords tend to cause the stream to become wider, shallower and rutted making fish passage difficult during low flows.

Hunt Creek ford crossing, site **981699** (Photo 33), is another example of a ford crossing with potential for sediments to enter the creek from the disturbed soil. The channel also becomes wider, shallower and rutted making fish passage difficult.

Quilomene Creek – WRIA 40.0613 (Map on page 19, Figure 6)

Quilomene Creek was surveyed on foot or the adjacent road was driven from the mouth at the Columbia River upstream to the confluence of Hunt and Quilomene Creeks. All Quilomene Creek crossings are passable ford crossings, (sites **981553, 981704 981703, 981702, 981701**). Fish were observed up to site 981703.

Features at site **981615** include a dam and a water diversion. The man-made dam, located off channel, adjacent to Quilomene Creek creates a spring-fed pond which maintains a constant water level. The diversion ditch off Quilomene Creek is bermed, preventing Quilomene Creek water from being diverted into the pond. No fish were observed in the pond. The outflow channel has a 1.0 meter drop into Quilomene Creek, making fish access into the pond nearly impossible.

The potential of this pond to provide salmonid habitat is questionable due to high water temperature and needs further investigation. WDFW Regional Fish Biologist, Eric Anderson, believes it may provide potential habitat for rainbow trout which are currently in Quilomene Creek. It may be possible to provide better fish access by eliminating the berm blocking flow into the diversion ditch and making this the outlet. The diversion ditch is longer and has less gradient than the present outflow channel.

Site **981614** is an old dam, breached in two places so that it cannot impound water. An old diversion channel is bermed at the point of diversion off Quilomene Creek. A culvert in the berm, perched about one foot above the creek, could possibly divert water at high flow stranding fish. The culvert should be removed and the berm restored.

Brushy Creek – WRIA 40.0612 (Map on page 19, Figure 6)

The first tributary to Quilomene Creek, Brushy Creek, was surveyed from the confluence with Quilomene Creek upstream to the Wildlife Area boundary. There are no features within the Quilomene unit. The old jeep trail is barely discernable in places. Many small trout were observed in this creek.

Right Bank Tributary – WRIA 40 (Map on page 19, Figure 6)

The second tributary is a right bank, unnamed stream that parallels Quilomene Ridge Road, also called Army Road on the WDFW Green Dot map. (Boise Cascade Corporation et. al. 2000.). This stream was considered not fish bearing due to insufficient flow duration (less than 3 continuous months). This small stream was dry when surveyed in July, 2002. Four culvert crossings were inventoried on Quilomene Ridge Road (sites 981611, 981612, 981617, 981618), all not fish bearing.

Hunt Creek – WRIA 40.0000 (Map on page 20, Figure 6)

The only feature on Hunt Creek is a passable ford crossing located at the confluence with Quilomene Creek, site **981699**. A decommissioned road continues along Hunt Creek for about a half mile but does not cross the creek.

Whiskey Dick Unit

Whiskey Dick Creek Watershed

Whiskey Dick Creek – WRIA 40.0555 (Map on page 20, Figure 7)

The Whiskey Dick Creek basin lies in the dry, shrub-step habitat along the Columbia River south of the Quilomene Unit. The survey was conducted during July and August 2002. No natural or man-made fish barriers were encountered on Whiskey Dick Creek and tributaries. Seven passable ford crossings were recorded on sections of stream having potential fish use.

Fish presence is unknown upstream of the confluence with North Fork Whiskey Dick, where flows become intermittent. This stream could be used by fish up to the Kohler Springs beaver pond during winter and spring high flows. Above the springs however, the stream is more intermittent with a very small channel, and fish presence is unlikely. Stream gradient averages 4% with occasional segments up to 10%.

Whiskey Dick Creek was walked or the adjacent road was driven from the mouth at the Columbia River to about a half mile upstream of Buckhorn Springs where the road forks.

The stream channel measures about 1.5 meters at bankfull width where Whiskey Dick Creek enters the Columbia River. Site **981619** is a ford crossing about 300 meters upstream of the bay at RM 0.20. The stream at this point has thick willow and red osier dogwood canopy cover. Beyond the riparian corridor is sagebrush desert with no tree cover. Rushes and other aquatic plants grow along the wetted channel providing good instream cover.

Approximately 200 meters upstream of the North Fork Whiskey Dick Creek confluence is a ford crossing, site **981623**, at RM 1.56. The stream goes subsurface at this point. Bankfull width is about 0.9 meters with no cover provided by the sagebrush riparian. The stream remains dry for another 500 meters to a ford crossing, site **981624**, at RM 1.96. Another 250 meters upstream is a ford crossing, site **981625** at RM 2.2.

Beyond site 981625, the stream is intermittent with some shrubs in the riparian zone. Upstream another 100 meters is the next ford crossing, site **981626**, at RM 2.34. At RM 3.34 is site **981627**, a ford crossing. Site **981628**, at RM 4.27, is also a ford crossing. At this point, it is unlikely that the stream provides sufficient flow to sustain fish use for a minimum of three consecutive months.

Upstream there are three more ford crossings, sites **981629** at RM 5.47, **981630** at RM 6.11 and **981631**, at RM 7.14. The road along the stream channel has been washed out by the stream in several places. The stream has some intermittent flow with small pools up to Buckhorn Springs. Two crayfish were seen in the stream but no fish were observed.

Jacknife Creek – WRIA 40.0000 (Map on page 20, Figure 7)

Approximately 50 meters upstream of the confluence of Jacknife and Whiskey Dick Creeks is a ford crossing, site **981620** at RM 0.03. Fish use is unknown. The channel is mostly dry. There are some cattails and other aquatic plants and several small, seep springs that begin approximately 250 meters upstream of the mouth. At about 280 meters upstream is another ford crossing, site **981621**, RM 0.17. Upstream of this site, the stream channel was dry with an average bankfull width of 0.7 meters. Flow originates from seep springs located 25 meters downstream of this crossing. The survey ended at site 981621 where the stream is unlikely to sustain three months of flow.

North Fork Whiskey Dick Creek – WRIA 40.0561 (Map on page 20, Figure 7)

The stream was dry at the time of the survey. This stream does not likely provide three months of sufficient flow to sustain fish, and it is considered not fish bearing. There is a ford crossing, site **981622** just upstream of the mouth. The riparian corridor upstream, is sagebrush desert providing no canopy cover for the stream channel. Bankfull width averages 0.9 meters. The survey continued up the road paralleling the creek to Bohinkleman Springs just outside the Wildlife Area boundary.

Hartman Creek – WRIA 40.0576 (Map on page 20, Figure 7)

The creek was dry at the time of the survey. This stream does not likely provide three months of flow sufficient to sustain fish, and it is considered not fish bearing. The mapped crossing at the mouth of Hartman Creek is covered with cattails and is not drivable. The creek was surveyed from the mouth to the second road crossing in the middle of Section 32, T18N, R22E where it is definitely not fish bearing. No features were inventoried.

RECOMMENDATIONS

Of the 36 fish passage barriers identified on WDFW lands during the LT Murray WLA inventory, 34 of the barriers have been prioritized for correction. Additionally, one unscreened diversion has been prioritized for repair. The next step for WDFW, after identifying and prioritizing fish passage barriers and unscreened diversions, is barrier correction and screening.

Fish passage and screening projects will increase production and survival of many Washington State salmonids, including ESA listed species, in a relatively short amount of time. Screening water diversions will improve conditions for fish migration and prevent fish from entering irrigation canals and fields, eliminating the risk of fish stranding at the end of the irrigation season.

Salmonid habitat reclamation through barrier correction does not assume habitat will immediately be used by target salmonids. Many brood years may be required before newly opened habitat is fully utilized. To wholly realize potential habitat gain, other non-WDFW

owned barriers will also need to be corrected. Additional factors, other than the inaccessibility of stream habitat caused by fish migration barriers, can affect fish production, including agricultural diversions, chemical contamination, channelization, localized extirpation of fish populations, non-native fish competition and habitat degradation.

WDFW is committed to removing fish barriers and screening diversions on WDFW lands. WDFW biologists are currently planning for several fish passage and habitat enhancement projects on Robinson Creek and Ainsley Creek, within the LT Murray WLA Unit, for 2003. All of the projects will involve culvert removal and road abandonment. The two gravity diversions, sites 981614 and 981615, in the Quilomene watershed of the Quilomene Unit, will be addressed in the future. Planning for future fish passage, screening, and habitat enhancement projects on WDFW lands will continue.

Robinson Creek Projects proposed for 2003

WDFW proposes to remove culverts on Robinson Creek and its tributaries, at sites 981502, 981503, 981505, 981506, 981508, restore channel function and place large woody debris (LWD) in the channel at the site locations for habitat enhancement. WDFW proposes to pull the cross-drain culverts on the small, spring-fed tributaries to Robinson Creek at sites 981507 and 981520, and place LWD for habitat enhancement.

Ainsley Creek Projects proposed for 2003

WDFW proposes to remove culverts on Ainsley Creek, at sites 981504, 981521 and 981522, and place LWD for habitat enhancement.

Proposed Projects for 2004

Plans are currently underway to address fish passage barriers in the NF Manastash and Taneum Creek watersheds. Projects in these watersheds are scheduled for 2004.

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APPENDIX A

A comprehensive list of all features evaluated during the LT Murray Wildlife Area Fish Passage Barrier and Surface Water Diversion Inventory. Features are sorted by Wildlife Area Unit, Tributary and Stream Name.

Stream	Tributary To	Site ID	Lat	Long	WRIA	Fish Use	Feature Type	Owner Type
LT Murray Unit								
South Riggs Canyon Cr	Manastash Cr	981537	46.9615804	-120.7070339	39	no	culvert	state
		981542	46.9559859	-120.7048757	39	no	culvert	state
Unnamed	South Riggs Canyon Cr	981538	46.9591211	-120.7109604	39	no	culvert	state
		981539	46.9566188	-120.7167969	39	no	culvert	state
Unnamed	Manastash Cr	981540	46.9542216	-120.7205567	39	no	culvert	state
		981541	46.9546402	-120.7244613	39	no	culvert	state
Unnamed	SF Manastash Cr	981528	46.9722525	-120.8100366	39	no	culvert	state
		981529	46.9857291	-120.8352526	39	no	culvert	state
		981530	46.9855936	-120.8356845	39	no	culvert	state
NF Manastash Cr	Manastash Cr	981552	47.0333001	-120.8699330	39.0995	yes	culvert	state
		981554	47.0034563	-120.8013413	39.0995	yes	other	state
Unnamed	NF Manastash Cr	981524	47.0392172	-120.8282511	39.1001	unknown	culvert	state
		981525	47.0409270	-120.8313870	39.1001	unknown	culvert	state
		981526	47.0412509	-120.8318064	39.1001	unknown	culvert	state
		981550	47.0377545	-120.8958733	39.1004	yes	pump	state
		981551	47.0298109	-120.8428018	39	no	culvert	state
		981555	47.0022992	-120.7991793	39	no	culvert	state
		981559	46.9945931	-120.7935350	39	no	culvert	state
		981560			39	no	culvert	state
		981561	46.9855755	-120.7688911	39	no	culvert	state
		981562	46.9840962	-120.7646342	39	no	culvert	state
		981563	46.9783432	-120.7559887	39	no	culvert	state
		981564	46.9750124	-120.7529851	39	no	culvert	state
		981569	47.0411947	-120.8766858	39.1002	yes	dam	state
		981570	47.0382692	-120.8759507	39.1002	yes	culvert	state
		981571	47.0423935	-120.8756982	39.1002	yes	culvert	state
		981572	47.0634657	-120.8857150	39.1002	no	culvert	state
		981573	47.0554800	-120.8765300	39.1002	no	culvert	state
		981574	47.0531276	-120.8760752	39.1002	no	culvert	state
		981575	47.0532089	-120.8762013	39.1002	yes	dam	state
		981576	47.0407409	-120.8759560	39	no	culvert	state
981577	47.0310417	-120.8708816	39	yes	culvert	state		
981580	47.0312239	-120.8745483	39	yes	culvert	state		
Whisky Canyon Cr		981556	47.0041824	-120.8100043	39.1000	yes	culvert	state
		981557	47.0049143	-120.8110374	39.1000	yes	culvert	state
		981558	47.0082005	-120.8154987	39.1000	yes	culvert	state
		981565	47.0086804	-120.8163863	39.1000	unknown	culvert	state
Unnamed	Whisky Canyon Cr	981566	47.0084603	-120.8162315	39	no	culvert	state
Robinson Cr	Yakima R	981501	47.0145522	-120.7131877	39.1064	yes	culvert	state
		981502	47.0173719	-120.7399264	39.1064	yes	culvert	state
		981505	47.0196735	-120.7483009	39.1064	yes	culvert	state
		981506	47.0198571	-120.7502103	39.1064	yes	culvert	state

Stream	Tributary To	Site ID	Lat	Long	WRIA	Fish Use	Feature Type	Owner Type
Ainsley Cr	Robinson Cr	981504	47.0170557	-120.7392559	39.1065	yes	culvert	state
		981521	47.0090190	-120.7529243	39.1065	yes	culvert	state
		981522	47.0089139	-120.7587378	39.1065	yes	culvert	state
Unnamed	Robinson Cr	981503	47.0172312	-120.7397244	39	no	culvert	state
		981507	47.0195896	-120.7529131	39	no	culvert	state
		981508	47.0335985	-120.7757267	39.1067	yes	culvert	state
		981520	47.0249293	-120.7738374	39	no	culvert	state
Unnamed	Joe Watt Cr	981510	47.0556247	-120.8042348	39	no	culvert	state
		981512	47.0552203	-120.7767192	39	no	culvert	state
Joe Watt Cr	Taneum Ditch Canal	981509	47.0507356	-120.8085504	39.1084	no	culvert	state
		981511	47.0584368	-120.7945124	39.1084	no	culvert	state
		981513	47.0637631	-120.7559715	39.1084	no	culvert	state
		981514	47.0707372	-120.7384080	39.1084	yes	culvert	state
Taneum Cr	Yakima R	981516	47.1091728	-120.8566816	39.1081	yes	other	federal
Cedar Cr	Taneum Cr	981517	47.1138339	-120.8847968	39.1100	yes	culvert	state
Rattlesnake Cr		981543	47.0716967	-120.7602789	39.1082	no	culvert	state
		981548	47.0774649	-120.7473707	39.1082	no	culvert	private
Shadow Cr		981519	47.0989288	-120.8723537	39.1098	yes	culvert	state
		981650	47.1058866	-120.8585922	39.1098	yes	dam	state
Unnamed	Shadow Cr	981518	47.1002044	-120.8743103	39	no	culvert	state
Unnamed	Taneum Cr	981515	47.0874600	-120.8168181	39.1095	unknown	culvert	state
		981523			39.1099	unknown	other	state
		981544	47.0702706	-120.7925575	39	no	culvert	state
		981545	47.0698871	-120.7945574	39.1092	no	culvert	state
		981546	47.0707710	-120.7992452	39	no	culvert	state
		981583	47.0998745	-120.8592057	39.1097	yes	culvert	state
		981585	47.1036731	-120.8904607	39	no	culvert	state
		981586	47.1037401	-120.8898913	39	no	culvert	state
		981587	47.1085926	-120.8870519	39	unknown	other	state
		981588	47.1110511	-120.8873995	39	unknown	other	state
		981589	47.0823889	-120.8296586	39.1095	unknown	culvert	state
		981590	47.0932443	-120.8405378	39.1096	no	culvert	state
		981591	47.0969879	-120.8524752	39	no	culvert	state
		981609	47.0719459	-120.8369835	39	no	culvert	state
		981610	47.0716755	-120.8352294	39.1095	no	culvert	state
		981725			39.1099	unknown	other	state
		Yahne Cr		981592	47.0864977	-120.8089243	39.1093	unknown
981594	47.0761899			-120.8165635	39.1093	no	culvert	state
981608	47.0670807			-120.8255915	39.1093	no	culvert	state
Unnamed	Yahne Cr	981593	47.0788032	-120.8149908	39	no	culvert	state
		981595	47.0783529	-120.8109280	39.1094	no	other	state
		981606	47.0656552	-120.8156582	39.1094	no	culvert	state
		981607	47.0659223	-120.8168012	39	no	culvert	state
Morrison Canyon Cr	Yakima R	981600	47.1158695	-120.8076851	39.1230	unknown	dam	state
		981601	47.1165362	-120.8094894	39.1230	no	culvert	state
		981602	47.1171124	-120.8161905	39.1230	no	culvert	state
		991464	47.1160507	-120.796196	39.1230	unknown	culvert	state
Unnamed	Morrison Canyon Cr	981549	47.1138487	-120.8053581	39	no	culvert	state
		981604	47.1142406	-120.8401511	39	no	culvert	state
		981605	47.1147419	-120.8433052	39	no	culvert	state

Stream	Tributary To	Site ID	Lat	Long	WRIA	Fish Use	Feature Type	Owner Type
Unnamed	Morrison Canyon Cr	991752	47.1243973	-120.8021469	39.1232	no	culvert	state
Moonlight Canyon Cr		981603	47.1184168	-120.8276319	39	no	culvert	state
Quilomene Unit								
Quilomene Cr	Columbia R	981553	47.1122711	-120.0328592	40.0613	yes	other	state
		981614	47.1038032	-120.0868404	40.0613	yes	dam/gravity	state
		981701	47.1004351	-120.1010717	40.0613	yes	other	state
		981702	47.1005946	-120.1004211	40.0613	yes	other	state
		981703	47.1021689	-120.0954205	40.0613	yes	other	state
		981704	47.1090269	-120.0681527	40.0613	yes	other	state
Hunt Cr	Quilomene Cr	981699	47.0773240	-120.1720573	40.0642	unknown	other	state
Brushy Cr		981731			40.0612	yes	other	state
Unnamed		981611	47.0986149	-120.0480191	40	no	culvert	state
		981612	47.0986149	-120.0480191	40	no	culvert	state
		981613	47.1031998	-120.0902317	40	no	culvert	state
		981615	47.1101239	-120.0662789	40	unknown	dam/gravity	state
		981617	47.1013177	-120.0442580	40	no	culvert	state
		981618	47.0996639	-120.0465846	40	no	culvert	state
Wide Hollow Cr		981705	47.0857395	-120.1257278	40.0638	no	other	state
		981700	47.0859042	-120.1425411	40.0639	no	other	state
Whiskey Dick Unit								
Whiskey Dick Cr	Columbia R	981619	47.0242512	-120.0224462	40.0591	yes	other	state
		981623	47.0274866	-120.0454993	40.0591	unknown	other	state
		981624	47.0239946	-120.0514744	40.0591	unknown	other	state
		981625	47.0220050	-120.0556461	40.0591	unknown	other	state
		981626	47.0208427	-120.0576925	40.0591	unknown	other	state
		981627	47.0142227	-120.0752480	40.0591	unknown	other	state
		981628	47.0053953	-120.0814232	40.0591	no	other	state
		981629	46.9951472	-120.1006555	40.0591	no	other	state
		981630	46.9929743	-120.1342204	40.0591	no	other	state
Jacknife Cr	Whiskey Dick Cr	981631	46.9932682	-120.1131914	40.0591	no	other	state
		981620	47.0305594	-120.0349595	40	yes	other	state
NF Whiskey Dick Cr		981621	47.0323429	-120.0351071	40	no	other	state
		981622	47.0288139	-120.0443453	40	no	other	state
Outside of LT Murray Wildlife Area Boundary								
Yakima R	Columbia R	981657	47.0528756	-120.6490981	39.0002	yes	gravity	private
NF Manastash Cr	Manastash Cr	981500	46.9665413	-120.7427390	39.0995	yes	culvert	county
		981527	46.9705166	-120.7496155	39.0995	yes	pump	private
		981578	47.0462814	-120.9007325	39.0995	yes	culvert	state
		981579	47.0472947	-120.9015104	39.0995	yes	culvert	state
		981581	47.0574607	-120.9242184	39.0995	yes	culvert	state
		981582	47.0543303	-120.9310590	39.0995	yes	culvert	federal
Unnamed	NF Manastash Cr	981567	47.0453788	-120.9014355	39	yes	culvert	state
		981568	47.0436921	-120.9077549	39	yes	other	state
Unnamed	SF Manastash Cr	981531	46.9985680	-120.8516996	39	no	culvert	private
		981532	47.0119569	-120.8859432	39	no	culvert	private

Stream	Tributary To	Site ID	Lat	Long	WRIA	Fish Use	Feature Type	Owner Type
Unnamed	SF Manastash Cr	981533	47.0044250	-120.8818633	39	no	other	private
		981534	47.0042516	-120.8822334	39	yes	other	private
		981535	47.0129525	-120.8699272	39	no	other	private
		981536	47.0136362	-120.8711545	39	no	other	private
Manastash Cr	Yakima R	981616	46.9889233	-120.6013509	39.0994	yes	dam/gravity	private
		981632	46.9939742	-120.5913160	39.0994	yes	pump	private
		981633	46.9914555	-120.5938294	39.0994	yes	dam/pump	private
		981634	46.9887350	-120.6016281	39.0994	yes	dam/pump	private
		981635	46.9875192	-120.6054115	39.0994	yes	pump	private
		981636	46.9872885	-120.6090415	39.0994	yes	pump	private
		981637	46.9836396	-120.6215119	39.0994	yes	dam/pump	private
		981638	46.9832474	-120.6230204	39.0994	yes	pump	private
		981639	46.9815652	-120.6293615	39.0994	yes	dam/gravity	private
		981640	46.9791596	-120.6336091	39.0994	yes	pump	private
		981641	46.9782032	-120.6365281	39.0994	yes	dam/gravity	private
		981642	46.9761187	-120.6468263	39.0994	yes	pump	private
		981643	46.9722379	-120.6639399	39.0994	yes	dam/gravity	private
		981644	46.9707411	-120.6723901	39.0994	yes	gravity	private
		981645	46.9691815	-120.6752357	39.0994	yes	dam/gravity	private
		981646	46.9691587	-120.6752271	39.0994	yes	gravity	private
		981647	46.9691576	-120.6758654	39.0994	yes	dam/pump	private
		981648	46.9691624	-120.6759437	39.0994	yes	other	private
		981649	46.9693573	-120.6768808	39.0994	yes	dam/gravity	private
		981707	46.9656041	-120.7327879	39.0994	yes	pump	private
		981708	46.9652481	-120.7285351	39.0994	yes	pump	private
		981709	46.9654004	-120.7270278	39.0994	yes	pump	private
		981710	46.9657869	-120.7207413	39.0994	yes	pump	private
		981711	46.9667883	-120.7118025	39.0994	yes	dam/gravity	private
		981712	46.9664270	-120.7016260	39.0994	yes	pump	private
		981713	46.9693170	-120.6768904	39.0994	yes	pump	private
		981714	46.9684821	-120.6804656	39.0994	yes	pump	private
		981715	46.9682957	-120.6831485	39.0994	yes	pump	private
		981716	46.9679975	-120.6840399	39.0994	yes	pump	private
		981717	46.9680322	-120.6921480	39.0994	yes	other	private
981718	46.9668038	-120.7004721	39.0994	yes	pump	private		
Robinson Cr	Packwood Canal	981584	47.0141522	-120.7054300	39.1064	yes	culvert	county
		981596	47.0139274	-120.6999371	39.1064	yes	culvert	private
		981597	47.0141813	-120.6992287	39.1064	yes	dam/gravity	private
		981598	47.0141034	-120.6982170	39.1064	yes	culvert	private
		981599	47.0152716	-120.6950889	39.1064	yes	culvert	county
		981651	47.0151433	-120.6918146	39.1064	yes	culvert	county
		981652	47.0151448	-120.6922821	39.1064	yes	pump	private
		981653	47.0149113	-120.6863826	39.1064	yes	culvert	private
		981654	47.0159143	-120.6826972	39.1064	yes	gravity	private
		981655	47.0183454	-120.6769130	39.1064	yes	culvert	county
		981658	47.0294158	-120.6505829	39.1064	yes	culvert	county
		981659	47.0283419	-120.6530171	39.1064	yes	culvert	county
		981667	47.0308804	-120.6410518	39.1064	yes	dam/pump	private
		981668	47.0305376	-120.6487517	39.1064	yes	dam/gravity	private
		981672	47.0226027	-120.6668063	39.1064	yes	gravity	private

Stream	Tributary To	Site ID	Lat	Long	WRIA	Fish Use	Feature Type	Owner Type
Robinson Cr	Packwood Canal	981683	47.0296031	-120.6503119	39.1064	yes	pump	private
		981684	47.0291374	-120.6507177	39.1064	yes	dam/gravity	private
		981685	47.0268117	-120.6549456	39.1064	yes	culvert	private
		981686	47.0218814	-120.6582889	39.1064	yes	other	private
		981692	47.0195806	-120.6744800	39.1064	yes	culvert	private
		981693	47.0215867	-120.6726596	39.1064	yes	dam/gravity	private
		981694	47.0184366	-120.6765881	39.1064	yes	gravity	private
		981695	47.0197191	-120.6742657	39.1064	yes	gravity	private
Packwood Canal	Yakima R	981656	47.0490625	-120.6478203	39	yes	gravity	private
		981660	47.0103804	-120.6134796	39	yes	dam	private
		981661	47.0104663	-120.6131019	39	yes	culvert	county
		981662	47.0105263	-120.6128458	39	yes	pump	private
		981663	47.0099834	-120.6055584	39	yes	dam	private
		981664	47.0172042	-120.6241092	39	yes	dam	private
		981665	47.0176481	-120.6247769	39	yes	gravity	private
		981666	47.0211339	-120.6267722	39	yes	gravity	private
		981669	47.0114409	-120.6190189	39	yes	gravity	private
		981670	47.0115261	-120.6191792	39	yes	gravity	private
		981671	47.0140681	-120.6215308	39	yes	gravity	private
		981673	47.0162757	-120.6226649	39	yes	pump	private
		981674	47.0157201	-120.6222704	39	yes	pump	private
		981675	47.0168475	-120.6235460	39	yes	pump	private
		981676	47.0250820	-120.6322377	39	yes	dam	private
		981677	47.0252732	-120.6322128	39	yes	gravity	private
		981678	47.0282338	-120.6351444	39	yes	gravity	private
		981679	47.0283651	-120.6352755	39	yes	gravity/ pump	private
		981680	47.0286003	-120.6354625	39	yes	gravity	private
		981681	47.0295348	-120.6363723	39	yes	gravity	private
		981682	47.0307705	-120.6375713	39	yes	gravity	private
		981687	47.0321636	-120.6393328	39	yes	gravity	private
		981688	47.0378088	-120.6449484	39	yes	dam	private
		981689	47.0379624	-120.6450281	39	yes	gravity	private
981690	47.0396604	-120.6448931	39	yes	gravity	private		
981691	47.0480856	-120.6481564	39	yes	culvert	state		
Joe Watt Cr	Taneum Ditch Canal	981547	47.0712492	-120.7347898	39.1084	yes	culvert	county
		981706	47.0721461	-120.7335063	39.1084	yes	culvert	private
		981719	47.0721972	-120.7335345	39.1084	yes	dam/gravity	private
Rattlesnake Cr	Taneum Cr	981548	47.0774649	-120.7473707	39.1082	no	culvert	state
Taneum Cr	Yakima R	981696	47.0818936	-120.7337505	39.1081	yes	fishway/ dam/gravity	federal
		981697	47.0814050	-120.7474112	39.1081	yes	fishway/ dam/gravity	private
		981698	47.0863542	-120.7641550	39.1081	yes	fishway/ dam/gravity	federal
		981720			39.1081	yes	other	private
		981730			39.1081	yes	gravity	private
Horseshoe Canyon Cr	Yakima R	993907	47.14005999	-120.79805000	39.1235	unknown	culvert	state
		993908	47.12993999	-120.78085000	39.1230	yes	culvert/other	state
		993909	47.12530000	-120.78274000	39.1230	yes	culvert	private
		991463	47.1368217	-120.8116684	39.1235	no	culvert	state

